Nutrition in Critically ill Burns & Trauma

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Nutrition in Critically Ill Burns & Trauma

Who is a critically ill?

• Any body who needs *constant monitoring and therapy* to prevent and treat organ-system dysfunction is a critically ill patient
Nutrition in Critically Ill Burns & Trauma

Who is a critically ill?

• Any body who needs *constant monitoring and therapy* to prevent and treat organ-system dysfunction is a critically ill patient.

• Critically ill burns & trauma patients have a *very high metabolic response* and are potentially on the verge of decompensation of organ function.
nutrition in critically ill burns & trauma

• Type of burn injury

  injury from flame
  injury from hot liquids
  injury from radiation
  injury from chemicals
  injury from electrocution
nutrition in critically ill burns & trauma

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  - injury from radiation
  - injury from chemicals
  - injury from electrocution

• Category of burn injury
  - 1\textsuperscript{st} degree (epidermal)
  - 2\textsuperscript{nd} degree (superficial dermal & deep dermal)
  - 3\textsuperscript{rd} degree (full thickness) & 4\textsuperscript{th} degree (beneath the skin upto bones)
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metabolic changes in burns & trauma

• ebb phase (12 –24h): ↓ metabolic rate, ↓ temp, ↓ O2 consumption, ↓ BP, vasoconstriction

• flow phase (beyond 24 h until recovery): hypercatabolism, utilisation of fat as energy source

• anabolic phase (onset of recovery): improved appetite, diuresis, stable vital signs
metabolic changes in burns & trauma

• insulin release & insulin resistance: this can persist for > 12 months and impaired glucose tolerance for > 3 yrs

• plasma catecholamines: 10-50 fold increase in major burns and can stay for > 3 yrs

• Plasma corticosteroids: similar

• cytokines: rise immediately after burns and comes down only after one month

• acute phase proteins: altered 5-7 days post burn
metabolic response to burns & trauma

endocrine response breaks down:

fatty deposits → fatty acids

liver/ muscle (glycogen) → glucose

muscle (amino acids) → amino acids
metabolic response to trauma & burns

• hypermetabolism
• insulin resistance
• lipolysis
• accelerated protein catabolism
metabolic response to trauma

measured REE (mREE) is greater than estimated REE (eREE)

in major trauma it may go up and last for 3-4 weeks following trauma
nitrogen loss in critically ill

- normal.................. 6-9 gms
- elective surgery.. 10 gms
- infection............... 15 gms
- sepsis................... 18 gms
- trauma..................... 21 gms
- burns.................... 28 gms
nitrogen loss in critically ill

• 1 gm N2 = 6.25gm protein = 31.25gm muscle mass
• 15 gms of N2 = 93.9gms of protein = 458.75gms of muscle mass
• 21 gms of N2 = 131.5 gms of protein = 656.25 gms of muscle mass
• 28 gms of N2 = 175 gms of protein = 875 gms of muscle mass
energy requirement in burns & trauma

Long formula:

\[ \text{BEE} \times \text{activity factor} \times \text{injury factor} \]

male BEE = 66.6 \(\uparrow\) 13.8 W \(\uparrow\) 5 H \(\uparrow\) 6.8 A
female BEE = 655 \(\uparrow\) 9.6 W \(\uparrow\) 1.9 H \(\uparrow\) 4.7 A
W = weight(kg), H = height(cm), A = age(yrs)

activity factor: 1.2 (if confined to bed), 1.3 (if out of bed)
injury factor: 2.1 for severe thermal burn
energy requirement in burns & trauma

Curreri formula:

age (16-59 yrs): Kcal/day = 25W \times 40 \text{ BSAB}

age ( > 60 yrs): Kcal/day = 20 W \times 65 \text{ BSAB}

(W = weight in kg, BSAB = % body surface area burnt)

a 50 yr old 60 kg person with 30% burn will need:

\((25 \times 60) \times (40 \times 30) = 1500 \times 1200 = 2700\) Kcal daily
energy requirement in burns & trauma

- **Direct colorimetry** uses *measured* O2 consumption and CO2 production to determine the REE (MREE)

\[
MREE = (3.9 \times \text{Vo2}) \times (1.1 \times \text{VCo2}) \times 60 \times 1/\text{BSA}
\]
energy requirement in burns & trauma

**formula for paediatric patients:**

- WHO
- RDA (recommended dietary allowance)
- Curreri junior
- Galveston infant
- Galveston revised
- Galveston adolescent
resting metabolic rate in burns at 30°C

- exceeds 140% of normal at admission
- reduces to 130% once wounds are fully healed
- Further reduces to 120% at 6 months and
- 110% at 1 yr
energy requirement in burns & trauma

administration of calories and protein:

• CHO should not be administered @ > 5-7 mg/ kg / min
• fat should not be more than 30 % of the caloric requirement and would be around 2.5 gm / kg / day
• protein up to 1.5 - 2 gms /day ; in renal failure : 0.5 gm/day

• nutrition should be started within first 48 hrs of injury or admission and average intake delivered within 1st wk should be 60 – 70 % of total energy requirement
early enteral nutrition in burns & trauma

Early enteral nutrition provided within 24 h of injury or intensive care unit admission, significantly reduces mortality in critically ill patients; a meta-analysis of randomised controlled trials.

antioxidant micronutrients in major trauma and burns

major trauma & burns have an

• increased free radical production which is proportional to severity of injury
• negative trace element balances: selenium, zinc, vit C & E
  status are altered in all injured patients
• Patients in major burns have copper deficiency
• In major burns, high dose vit C for 24 h achieve reduction in resuscitation fluid requirement by endothelial anti oxidant mechanisms both in animal models and in one human study

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immunity in major trauma and burns

• trauma *docs the ‘increased susceptibility’* of patients to infection (mechanism not known)

• Burns *decreases immunity* and major cause of morbidity and mortality in burns is sepsis
Immuno nutrition in major trauma and burns

- specific nutrients such as arginine, omega-3 PUFA, glutamine and nucleotides have been shown to modulate host response in animals but there is inconsistent clinical evidence.

- Theory:
  - arginine stimulates T lymphocytes and provides a substrate for generation of NO
  - omega-3 PUFA promotes synthesis of favourable prostaglandins. They are anti inflammatory agents
  - long chain omega-3 FA decreases production of eicosanoids, cytokines and adhesion molecules
  - nucleotides nonspecifically enhances immune competence
assessment of energy requirement in burns & trauma

subjective global assessment (SGA):
• weight loss
• food intake
• presence of significant g.i. symptoms
• functional status / energy level
• metabolic demand of the underlying disease states

on examination:
• depletion of subcut fat
• quadriceps and deltoid muscle wasting
• oedema
• ascites

each one is assigned category A (well nourished), category B (mildly malnourished), and category C (severely malnourished)
loss of lean body mass in burns

• 10 % loss of lean body mass decreases immune function
• 20% loss decreases wound healing
• 30 % loss leads to increased risk of pneumonia
• 40% loss leads to death

protein loss can remain upto one year

a severely burnt patient can develop cachexia in one month
Principles:

- Use the oral route if GIT is functional
- Initiate nutrition thru enteral route if pt is not expected to be on a full oral diet within 7 days
- If enteral route is contraindicated/ not tolerated, use PN within 48 h
- Administer at least 20% of calories and protein requirement enterally while reaching the goal with PN
- Maintain PN until pt tolerates 75% of calories thru enteral route and EN until he/she tolerates 75% calories through oral route
contraindication to EN

- Intractable vomiting, diarrhoea refractory to medical manag.
- distal high output intestinal fistula
- GI obstruction, ischaemia
- diffuse peritonitis
- severe shock, haemodynamic instability
- severe GI haemorrhage
- severe short bowel syndrome
- severe GI malabsorption
- inability to access GI tract
- paralytic ileus
Complications of EN

- diarrhoea
- nausea & vomiting
- constipation & faecal impaction
- aspiration pneumonia
- hyponatremia, overhydration
- hypernatremia, dehydration
- hypokalemia, hypomagnesemia, hypophosphatemia
- hyperkalemia
- Re-feeding syndrome
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Refeeding syndrome

• Refeeding in nutritionally depleted patients (≥ 10% loss of body weight over ≤ 6 months) should be done carefully so as not to overload a metabolic system that has adopted to minimal or no food intake. Intake should be increased stepwise over a week / 10 days. 

  hypo phosphatemia occurs when tissues begin to rebuild and is problematic if inadequate phosphate is given in the food. It causes major muscle weakness and glucose intolerance.
monitoring for nutrition

- **daily / alt days / biweekly:**
  - BUN, serum creatinine
  - plasma electrolytes
  - glucose, Ca, Mg, inorganic phos,
  - Hb, WBC, platelets,
  - triglycerides and transaminases
- serum albumin:  $t_{\frac{1}{2}}$ 14 – 20 days
- transferrin:  $t_{\frac{1}{2}}$ 9 days
- pre albumin:  $t_{\frac{1}{2}}$ 1 – 2 days
- retinol binding protein
- **nitrogen balance**
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nitrogen balance

\[
\frac{\text{protein intake}}{6.25} - (\text{UUN} \uparrow 4.0) \text{ gms over 12/24 h}
\]

- 0 to -5 ..... moderate stress
- < -5 ........ severe stress
parenteral nutrition in trauma & burns

• advantages:
  direct mixing in blood
  no risk of aspiration

• disadvantages:
  intestinal mucosal atrophy
  catheter related sepsis
  expensive
Summary of nutrition in trauma & burns

• trauma and burns are hyper metabolic states and protein loss is maximum in comparison to any other stress and this state persists for a long time
• early enteral nutrition is key to successful outcome in these conditions
• monitoring of nutritional status and complications of nutrition delivery are extremely important
• parenteral nutrition should be started if enteral nutrition is not possible within 48 h
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Thank you